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University of the Witwatersrand, Johannesburg

Faculty of Health Sciences

RESEARCH REPORT

Birth weight recovery among very low birth weight infants surviving to discharge from Charlotte Maxeke Johannesburg Academic Hospital, Neonatal unit

By Name: Jean Claude Mudahemuka

Student number: 500228

MMed in Paediatrics

Supervisor: Daynia Ballot

Associate Professor

Department of Paediatrics and Child Health

University of the Witwatersrand

DECLARATION

I, Jean Claude MUDAHEMUKA, declare that this research report is my own original work. It is being submitted for the degree of Master of Medicine in paediatrics at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

The research was published as an article in South African Journal of Child Health in November 2014. The article is attached as Appendix 1.

…………………………………………

The 19th day of January 2015

DEDICATION

To my beloved family I dedicate this work.

ACKNOWLEDGEMENTS

- First of all my gratitude goes to Professor Daynia Ballot for supervising this research despite her multiple occupation.

- I am thankful to Professor Cooper and the department of paediatrics at the University of the Witwatersrand for the training.
- I appreciate the staff of the research unit in the department for their facilitation in data collection.
- Last but not least my thanks go to the Rwandan Government for the sponsorship.

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ABBREVIATIONS

AGA: appropriate for gestational age

CGA: corrected gestational age

CMJAH: Charlotte Maxeke Johannesburg Academic Hospital

ELBW: extremely low birth weight

GV: growth velocity

HIV: human immunodeficiency virus

HMD: hyaline membrane disease

HT: hypertension

KMC: kangaroo mother care

LGA: large for gestational age

NCPAP: nasal continuous positive airway pressure

NEC: necrotizing enterocolitis

NPO: nil per os

NVD: normal vaginal delivery

O_2: oxygen

PDA: patent ductus arteriosus

PN: parenteral nutrition

SGA: small for gestational age

VLBW: very low birth weight

ZSW: Z scores for weight

ABSTRACT

Background: The recommended growth velocity of very low birth weight (VLBW) infants is 15 g/kg/day. Several factors have been associated with poor postnatal weight gain.

Objective: The aim of the present study is to provide current information on the postnatal growth of VLBW infants at Charlotte Maxeke Johannesburg Academic Hospital.

Methods: This is a retrospective longitudinal study of VLBW infants surviving to discharge from Charlotte Maxeke Johannesburg Academic Hospital, Neonatal Unit from August 2013 to October 2013.

Results: Sixty nine infants were included in the study. The mean growth velocity was 13.2 g/kg/day, the median weight loss was 7.69% and the median time for regaining birth weight was 16 days. Fifty one infants (73.9%) regained their birth weight at or before 21 days. There was a decrease in mean Z scores for weight from -0.32±1.25 at birth to -1.94±1.35 at discharge. A multiple linear regression showed a negative association between Z scores for weight at discharge and number of days nil per os without parenteral nutrition. Antenatal steroids were associated with poor growth velocity. There were no factors associated with regaining birth weight after 21 days on multiple logistic regression.

Conclusion: This study shows a growth velocity in VLBW infants approaching recommended standards. The number of days without parenteral nutrition and use of antenatal steroids are associated with poor postnatal growth.

CHAPTER 1 INTRODUCTION

Very low birth weight (VLBW) infants are born weighing less than 1500 grams and comprise between 1 and 2% of all live births, but contribute significantly to neonatal mortality and morbidity. [1, 2] At Charlotte Maxeke Johannesburg Academic Hospital (CMJAH) an early study has shown an overall survival of VLBW of 70.5%.[2] The same study has shown a mean birth weight of 1133.5 g, a mean gestational age of 29.9 weeks, the mean duration of hospitalization of 25.8 days.[2]. The study also documented a mean maternal age of 26.5 years, a prevalence of primiparous mothers of 37.3%. Bronchopulmonary dysplasia was present in 8.8%, 44.8% of mothers practiced kangaroo mother care (KMC), hyaline membrane disease (HMD) was present in 68.4%, and necrotizing enterocolitis was present in 5.4%. The same authors documented that the mean birth weight and the mean gestational age was greater in survivors than in those who died.[2]

Birth weight is a general index of the health of a newborn baby. [3] The growth of a newborn baby and specifically a VLBW infant reflects the development of its brain, liver, heart, muscle and other organs of the body. [3] One way of assessing the growth of an infant is by measuring weight growth velocity.

Weight growth velocity (g/kg/day) in infants summarizes infant weight gain over a certain period. It is a frequently used growth parameter in VLBW research. Actual growth velocity is calculated from daily weight increments. Patel AL and colleagues[4] in their study calculated actual growth velocity from 2 starting points: at birth and the day of life of regaining birth weight. These daily growth velocities were then averaged in order to give an overall growth velocity over the period of hospitalization. The same authors compared actual growth velocity and 2 methods of estimation of growth velocity which are the exponential method (EM) and the 2-point average weight model (2-PM). They reported that both the 2 point average weight model and exponential method are simple to use as they require only weight and the day of life at 2 time points. The 2-point average weight model uses simpler mathematics.[4] Griffin reported that after regaining their birth weight, VLBW infants have a target of adding 15 g/kg of weight daily.[5] The goal is to achieve a postnatal growth rate which approximates that of the normal foetus.[6]

Another way of assessing the growth of an infant is by calculating the Z score for weight at birth, throughout hospital stay and at discharge. By comparing the birth z score for weight and the discharge z score for weight, a researcher can evaluate the growth of an infant. Different growth charts have been developed in order to follow the growth of preterm infants, the Fenton growth chart being one of them have been validated as a reliable growth monitoring tool.[5]

Poor postnatal weight gain in VLBW infants is associated with prolonged hospital stay, increased cost of care and an increased risk of nosocomial infection. This is of major importance in overcrowded neonatal units in resource poor settings. There is also an association between retinopathy of prematurity and poor weight gain.[5, 7] Many factors affect postnatal weight gain in VLBW infants including necrotising enterocolitis (NEC), feeding intolerance, parenteral nutrition, type of enteral feed, chronic lung disease and neonatal sepsis.[5,8,9, 10] Ideally, VLBW infants should receive parenteral nutrition to ensure adequate nutrition because these infants receive low volumes of enteral feeds in the first days of their life in order to prevent NEC. Michael R. Uhing[11] reported that preterm infants below 30 weeks of gestation accumulate an energy deficit in the first 5 weeks. The same author also documented an improved weight gain when parenteral nutrition is started early and aggressively.[11] In addition, breast milk provided to these infants should be fortified.[11] Preterm milk (obtained from mothers of preterm infants) is often low in protein, sodium, calcium and phosphorous; therefore, preterm infants receiving expressed breast milk need human milk fortifiers. [5] South Africa is a country with limited health resources and parenteral nutrition is used on a limited basis to reduce costs. Breastfeeding of VLBW infants is suboptimal in many units – this is partly related to the human immunodeficiency virus (HIV) epidemic. In addition, breast milk fortifiers may not be used routinely. Kangaroo care is widely practiced and has been shown to improve postnatal weight gain in VLBW infants. (6, 12)

There is limited data regarding postnatal growth of VLBW infants in sub Saharan Africa. A study from Groote Schuur Hospital (Cape Town, South Africa) showed that the growth velocity of extremely low birth weight (ELBW) infants (<1000 grams at birth) in this unit was close to the internationally accepted norms.(13) The aim of the present study is to provide current information on the postnatal growth of VLBW infants at Charlotte Maxeke Johannesburg Academic Hospital. The information obtained will be used to inform future nutritional policy for VLBW in this unit.

CHAPTER 2 PATIENTS AND METHODS

This is a retrospective longitudinal study of VLBW infants admitted at Charlotte Maxeke Johannesburg Academic Hospital, neonatal unit within 72 hours of birth and surviving to discharge between August 2013 and October 2013.

In order to have a representative sample of the VLBW population at Charlotte Maxeke Johannesburg Academic Hospital, the sample size was calculated as follows, based on a prevalence of VLBW infants of 4.7% of live births (personal communication DE Ballot):

Sample Size (SS) = $[Z^2 x\ Px\ (1-P)] \div C^2$

SS = required sample size, Z = confidence level at 95% (standard value of 1.96, p = estimated prevalence of VLBW in the project area, c = margin of error at 5% (standard value of 0.05). A sample size of 69 infants was calculated.

Patient information of VLBW infants discharged from Charlotte Maxeke Johannesburg Academic Hospital was reviewed from 1st August 2013 until the desired sample size was achieved on 25th October 2014. Infants whose records were unobtainable or incomplete and those infants who died or were transferred to other units were not included.

VLBW infants admitted to the neonatal unit were managed according to the unit protocol. Babies were kept nil per os for the first 24 hours (as per unit protocol) and given an intravenous infusion of 10% dextrose water with electrolytes starting at 80 ml/kg/day. Orogastric feeds were then introduced at a volume of 20 to 30 ml/kg/day. Breast milk was the preferred feed. If maternal breast milk was not available, babies were fed a premature formula [PreNan Nestlé South Africa (Pty) Ltd]. Donor breast milk was not available during the study period. Enteral feeds were advanced daily at a rate of 20 to 30 ml/kg/day up to a maximum of 160 to 180 ml/kg/day based on the baby's clinical condition and evidence of feeding tolerance (see below). Parenteral nutrition was only provided to those infants with surgical conditions of the gastrointestinal tract or NEC. Breast milk was fortified [FM85 Nestlé South Africa (Pty) Ltd] once a volume of 20 ml per feed was achieved. Babies were weighed twice weekly on designated days. Basic demographic and clinical data was obtained from the computerised neonatal database. Neonatal data is collected and managed using REDCAP(14) electronic data capture tools hosted at the University of the Witwatersrand. This is done as ongoing clinical audit. Information not included in the database, including twice weekly weights and days of nil per os was obtained from patient's files. In the present study the number of days nil per os with or without parenteral nutrition was considered rather than the time to establish full enteral feeding. The information was thereafter captured in a

Microsoft Office Excel version 2007 then imported to Stata software version 13 (STATA StataCorp, College Station, Texas) for analysis.

Infant's weights were plotted using Fenton's growth charts.[5] Those with birth weights below the10th percentile were classified as small for gestational age (SGA) and those with birth weights above the 90th percentile were classified as large for gestational age (LGA). The Fenton chart (http://www.peditools.org/fenton2013/) was also used to calculate Z score for weight at birth and at discharge. The Fenton chart was also used to calculate Z score for weight every week until 63 days, using the corrected gestational age, as only very few babies were hospitalized for more than 63 days. Growth velocity was calculated for every infant by 2-point models average weight as shown in the following formula.

$GV= [1000 \times (Wn-W_1)] \div \{(Dn-D_1) \times [(Wn+W_1)/2]\}$

Wn: weight in grams at the end of time interval which is the discharge time; W_1: weight in grams at the beginning of time interval which is day 7 of life in most cases; Dn: end of time interval in days which is the discharge time; D_1: beginning of time interval in days which is day 7 of life in most cases.

The starting time taken was day 7 of life and if there was no weight recorded at day 7 of life, the closest next weight was taken. Two babies had the next weight close to the discharge weight, in those two infants the birth weight was taken as W_1. Day 7 was taken as the starting point as previous studies have shown that this is the time weight loss has reached its nadir.[13, 15]

Feeding intolerance was defined as a gastric residual volume of more than 50% of volume of the previous feed or total gastric residual volume >20% of the total volume of feed on the previous day. Bile stained gastric residuals, vomiting and abdominal distension was considered to be evidence of feeding intolerance or possible NEC. Resuscitation at birth was defined as the need for assisted ventilation with or without chest compressions or adrenaline.

Babies who were given supplemental oxygen without assisted ventilation at birth were not classified as needing resuscitation. NEC was defined as stage 2 or 3 using the modified Bell's criteria.[16] The need for assisted ventilation after initial resuscitation was defined as requiring either conventional mechanical ventilation or high frequency ventilation. During the study period, babies with respiratory failure were initially treated with nasal continuous positive airways pressure (NCPAP); only those babies failing NCPAP would be ventilated. Owing to limited resources, babies with a birth weight between 750 and 900 grams were only offered NCPAP, but not assisted ventilation, those weighing less than 750 grams did not get NCPAP.

Statistics: Data was described using standard statistical methods. Categorical variables were described using frequency and percentages, while continuous variables were described using mean and standard deviation or median and range, depending on the distribution of the data. Birth weight recovery after 21 days and growth velocity above 14 g/kg/day were used to separate babies into 2 groups. Univariate analysis was done using the Pearson Chi square test and Fisher exact test for categorical variables while student's t test was used for continuous variable. The univariate analysis was done in order to look for factors associated with the following parameters: birth weight recovery after 21 days, growth velocity, good growth velocity and Z score for weight. Parameters with a p value of <0.1 on univariate analysis were included in a multivariate analysis. In multivariate analysis a 95% CI were reported. The multivariate analysis used was either multiple linear regression or multiple logistic regression as explained below.

Simple linear regression was done for normally distributed continuous variables (growth velocity and z score for weight), those variables which were significant were analysed using multiple linear regression. A logistic regression analysis was done for binary variables to determine factors associated with good growth velocity and those associated with birth weight recovery after 21 days. A multiple logistic regression was there after done.

The study was approved by the Committee for Research on Human Subjects of the University of the Witwatersrand (clearance certificate number M130226).

CHAPTER 3 RESULTS

A total of 69 patients were reviewed. Thirty six (52.2%) were female while 33 (47.8%) were male. Among the 69 patients the majority of babies were singletons 54, (78.3%) whereas 15 (21.7%) were twins. Fifty two (75.4%) mothers attended antenatal clinic during pregnancy. Twenty two (31.9%) of the mothers were primiparous, the other parity and gravida parameters are depicted in figure 1. Only one mother had syphilis during pregnancy while 18 patients (26.1%) were HIV positive. There was no maternal tuberculosis or maternal diabetes among the study population. The majority of patients (56, 81.2%) were born with a 5 minute APGAR above 5. Most of the babies (49, 71%) were born by caesarean section; the remaining 20 patients (29%) were born by normal vaginal delivery. Forty eight infants (69.6%) received kangaroo mother care (KMC) among them 30 patients (43.5%) had continuous KMC while 18 patients (26.1%) had intermittent KMC. The majority of babies were fed formula (42, 60.9%), 5 infants (7.2%) received breast milk and formula while the remaining infants (22, 31.9%) received either breast milk or fortified breast milk. The remaining characteristics of patients are shown in Tables 1 and 2, which report categorical and continuous variables respectively.

Table 1. Characteristics of VLBW infants and their mothers (N: 69)

Variable		N (%)
Maternal HT (chronic or pregnancy induced)		16 (23.2)
Antenatal steroid received		27 (39.1)
Mode of delivery	Caesarean section	49 (71.0)
	NVD	20 (29.0)
AGA at birth		51 (73.9)
LGA at birth		6 (8.7)
SGA at birth		12 (17.4)
Time of initiation of feeding ≤48 hours		64 (92.8)
Feeding intolerance		24 (34.8)
NEC		3 (4.3)
Proven sepsis		18(26)
NCPAP		47 (68.1)
Assisted ventilation		12 (17.4)
PDA		10 (14.5)
Anaemia requiring blood transfusion		29 (42.0)
Neonatal jaundice requiring phototherapy		48 (69.6)
HMD		56 (81.2)
O_2 requirement at 28 days chronological age		13 (18.8)
Time of regaining birth weight ≤21 days		51 (73.9)
Type of feeding at discharge	Fortified breast milk	3 (4.4)
	Breast milk	19 (27.5)
	Breast milk and formula	5 (7.2)
	Formula only	42 (60.9)
Good growth velocity (>14 g/kg/day)		26 (37.7)
Appropriateness of weight for CGA at discharge	Appropriate	30 (43.5)
	$<10^{th}$ percentile	39 (56.5)

Table 2. Growth and other characteristics of VLBW (N: 69)

Variable	Mean or median*	SD or IQR*
Age of the mother in years	28	23 to 33
Gestational age at birth (weeks)	30	27 to 32
Z score for weight at birth (mean ± SD)	-0.37	± 1.25
Birth head circumference in cm	28	26 to 29
Birth weight in grams	1210	1030 to 1390
Time of initiation of feeding (hours)	25	19 to 32
Days NPO without total PN (days)	1	1 to 3
Days NPO with PN (days)	2	0 to 3
Percentage of weight loss	7.69	3.14 to 13.4
Time of regaining birth weight in days	16	12 to 22
Duration of ventilation in days (N:12)	6.5	4.5 to 13
Number of transfusions (N:29)	2	1 to 3
CGA at discharge in weeks (mean ± SD)	35	± 2.5
Z score for weight at discharge (mean ± SD)	-1.94	± 1.35
Growth velocity (mean ± SD)	13.2	±4.24
Duration of hospital stay (days)	35	25 to 53

* Median and interquartile range (IGR) are presented except otherwise specified. SD: standard deviation

Enteral feeds were initiated during 48 hours in the majority of babies (64, 92.8%) as depicted in figure 2; in addition 5 infants (7.2%) were fed after 48 hours of life. The median time of initiation of enteral feeds was 25 hours (range 19 to 32). Figure 2 shows the birth weight was recovered within 21 days in 51 infants (73.9%) when the remaining infants (18, 26%) regained their birth weight after 21 days. The median time of regaining birth weight was 16 days (range 12 to 22) and the median percentage weight loss was 7.69 (range 3.14 to 13.4). Twenty four infants (34.8%) had feeding intolerance ;with a median duration of 3 days (range 1.5 to 4.5) without parenteral nutrition and 2 days (range 0 to 5) with parenteral nutrition.

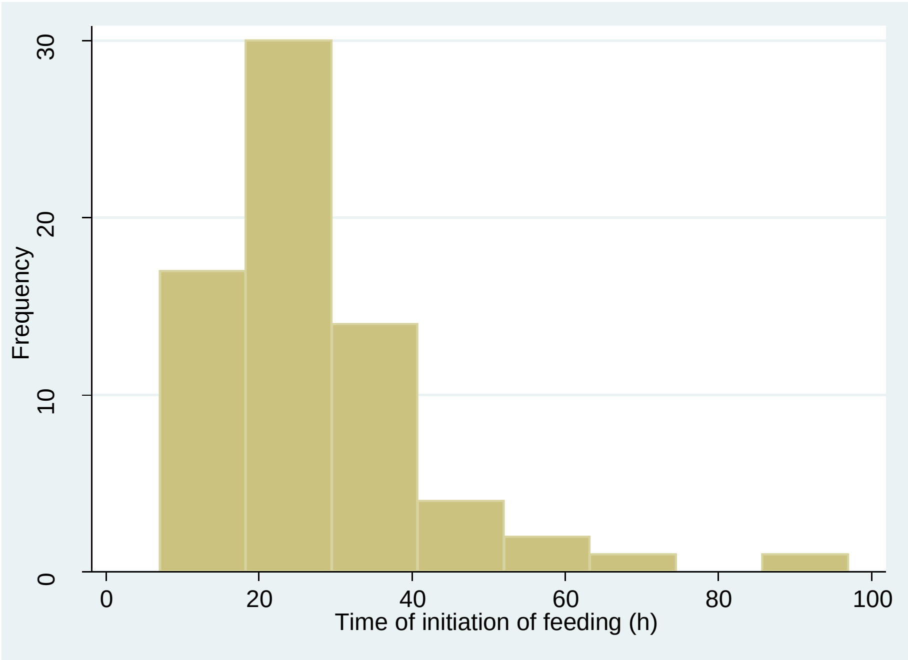

Figure 1. Time of initiation of feeding

Birth weight recovery after 21 days, univariate analysis showed a statistically significant association between birth weight recovery after 21 days and feeding intolerance (p: 0.031). Sepsis (p: 0.06) and oxygen requirement at 28 days (p: 0.086) approached statistical significance. There was no statistically significant association between birth weight recovery after 21 days and any of the other variables. A multiple logistic regression analysis showed no significant association between regaining birth weight after 21 days and feeding intolerance, sepsis or oxygen requirement at 28 days.

Growth velocity, in this study the mean growth velocity was 13.2±4.24 g/kg/day. In a simple linear regression, growth velocity was negatively associated with the number of days nil per os without parenteral nutrition (p: 0.005), number of days nil per os with parenteral nutrition (p: 0.026), duration of ventilation (p: 0.033), number of transfusions (p: 0.001), duration of hospital stay (p: 0.007) and administration of antenatal steroid (p: 0.02). A multiple linear regression, however, did not show any of the above factors to be significant.

There was no statistically significant difference between the mean growth velocity of appropriate for gestational age (AGA), small for gestational age (SGA) and large for gestational age (LGA).

Table 3. Mean growth velocity according to AGA, SGA and LGA (N: 69)

AGA/SGA/LGA	Number	Mean	95%CI
AGA	51	13.1	11.9-14.2
SGA	12	13.8	10.3-17.3
LGA	6	13.3	10.9-15.8

Good growth velocity (GV) (>14 g/kg/day) showed a significant association with antenatal steroids (p: 0.004) and the type of feeding at discharge (p: 0.051) approached statistical significance by univariate analysis. A multiple logistic regression was done to look for factors associated with good growth velocity. Administration of antenatal steroids had a negative impact on the growth velocity; this was the only statistically significant factor associated with good growth velocity (odds ratio 0.18, 95% CI: 0.05-0.60).

Table 4. Multiple logistic regression of factors associated with good GV

Variable	Odds ratio	95%CI	p-value
Antenatal steroids	0.18	0.05-0.60	**0.005**
Feeding intolerance	0.56	0.17-1.79	0.33
Constant (Intercept)	1.44	0.66-3.13	0.35

Z scores for weight (ZSW), the mean z scores for weight were -0.37±1.25 at birth and -1.94±1.35 at discharge. A simple linear regression has shown a negative association between z scores for weight at discharge and gestational age (p <0.0001), time of initiation of feeding (p: 0.037), number of days nil per os without parenteral nutrition (p <0.001), number of days nil per os with parenteral nutrition (p: 0.002), duration of ventilation (p: 0.018), and number of transfusions (p: 0.001). Figure 3 shows 3 scatter plots with regressed line numbered a, b and c indicating the relationship between z score for weight at discharge and 3 parameters (time of initiation of feeding as well as number of days nil per os with and without parenteral nutrition) demonstrate that when the time of initiation of feeding increase the discharge z scores for weight also decrease, when the number of days nil per os without parenteral nutrition increases the z scores for weight decrease and when the number of days nil per os with parenteral nutrition increases z scores for weight at discharge decrease. However multiple linear regression of these factors associated with z scores for weight at discharge on univariate analysis has shown that only the number of days NPO without PN remained statistically significant (p:0.047).

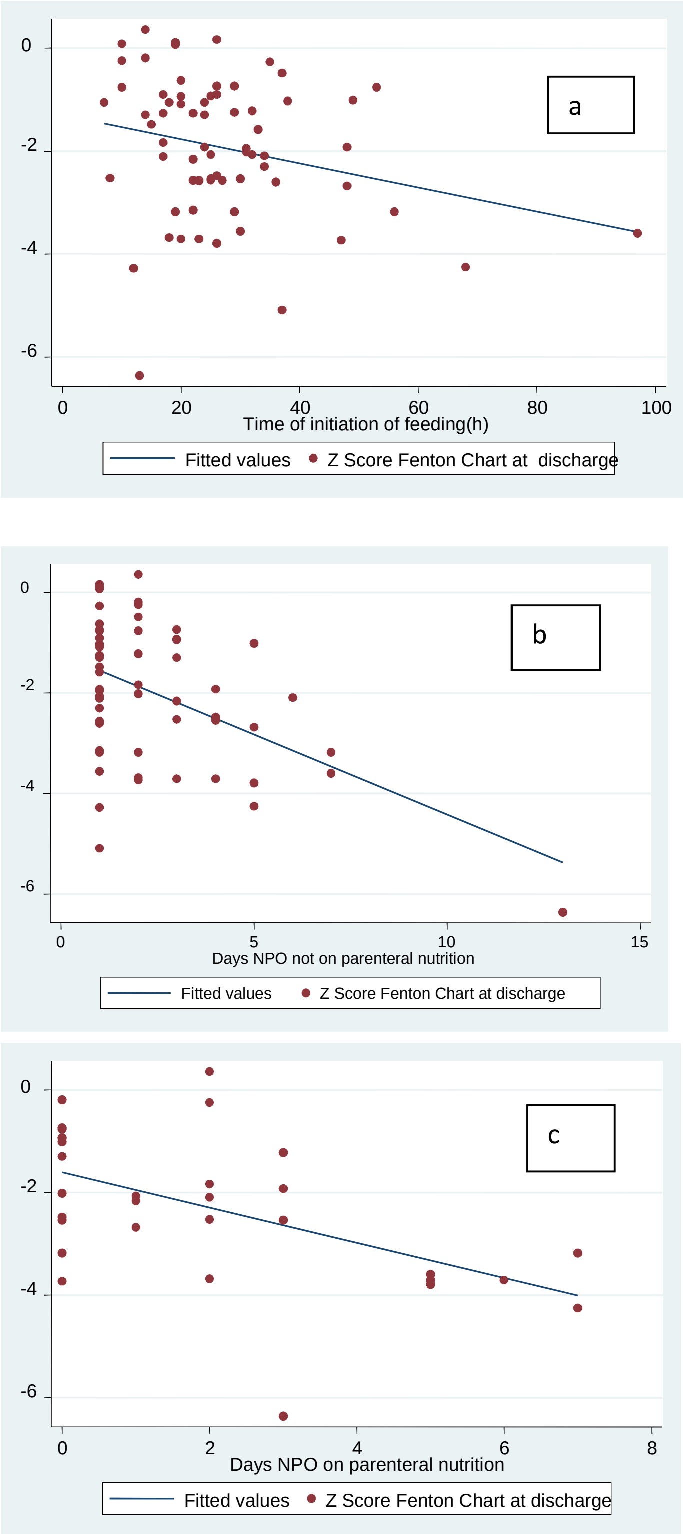

Figure 2 Scatter plots of z scores for weight at discharge

Table 5. Multiple linear regression of factors associated with ZSW at discharge

Variable	Coefficient	P value	(95% CI)
Gestational age	-0.2275422	0.399	(-0.97 0.51)
Time of initiation of feeding (h)	0.0336732	0.177	(-0.02 0.09)
Days NPO without PN	-0.6264679	**0.047**	(-1.24 -0.02)
Days NPO on PN	-0.3782152	0.206	(-1.13 0.37)
Duration of ventilation	0.2070505	0.101	(-0.07 0.49)
Number of transfusions	-0.5432966	0.103	(-1.29 0.20)
Constant (Intercept)	6.358175	0.399	(-14.25 26.97)

There was an overall decline in z scores for weight during hospital stay (see fig. 3). There was also a statistically significant decrease in z scores for weight from birth to discharge (paired t test $p<0.0001$) [fig. 4].

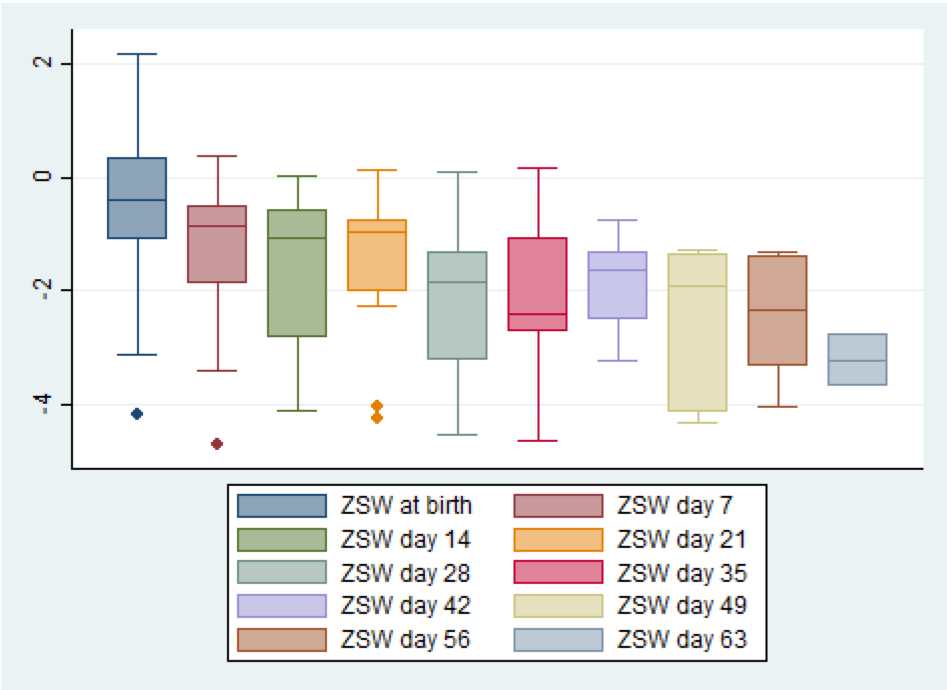

Figure 3 Z Scores for weight during hospital stay

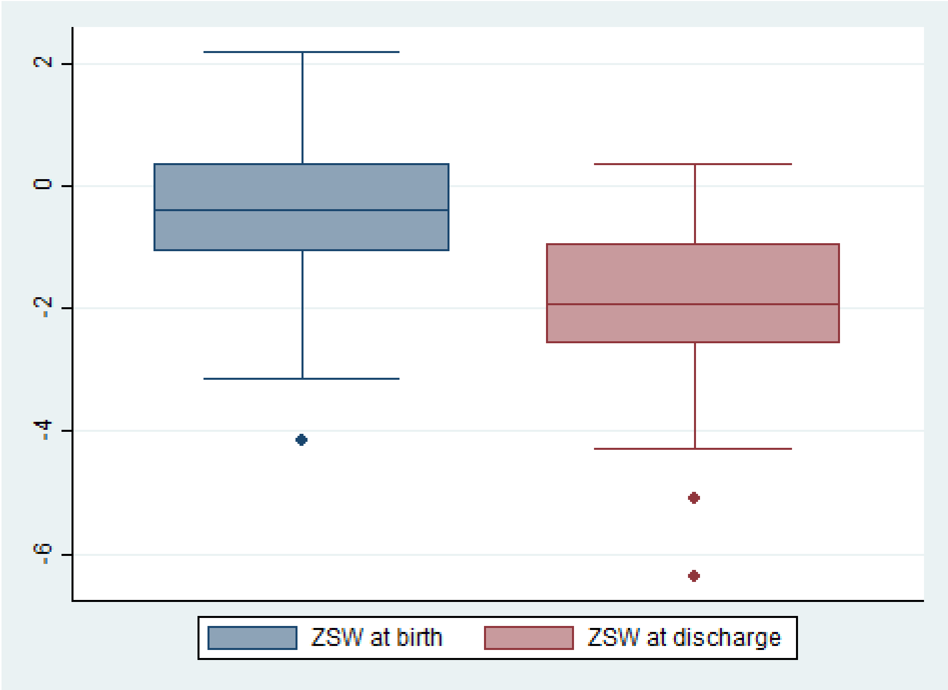

Figure 4 Z scores for weight at birth and at discharge

CHAPTER 4 DISCUSSION

This study is one of few evaluating growth in hospitalized preterm infants in sub-Saharan Africa. Infants were predominantly AGA (73.9%) which is slightly above the finding of a study done by Lima et al. [(8)] The median gestational age was 30 weeks, which is comparable to findings of Lima et al.[(8)] Others characteristics of babies are different but comparable to other studies: HMD was present in 81.2% whereas Ballot et al.[(2)] documented 299/437 (68.4) HMD, NEC was present in 4.3% in this study while it was 5.4% in the study done by Ballot [(2)] at an early date in the same hospital. A number of parameters were different to those found early such as chronic lung disease, patent ductus arteriosus and sepsis.

Some maternal characteristics are comparable to findings of an earlier study done at CMJAH[(2)] as 31.8% were primiparous in this study whereas it was 37.3% previously, 39% of mothers received antenatal steroid in this study compared to 36.5% in the earlier study. This study did not take into account whether mothers used a single or multiple courses of antenatal steroids. The type of steroid used (dexamethasone or hydrocortisone) was likewise not considered.

The results show that 92.8% of babies were fed at or before 48 hours and the median time of initiation of feeding was 25 hours which is in accordance with the unit protocol. At birth the mean Z score for weight was -0.37±1.25 which decreased to -1.94 ± 2.5 at discharge. This is similar to others reports. In a study done by Saluja et al.[(17)] the mean z score for weight were -1.17 at birth and -2.16 at discharge whereas Lima et al.[(8)] documented a drop of mean z scores for weight from -0.96 to -1.54 from birth to discharge. The prevalence of SGA at birth was 17.4% but increased to 56.4% at discharge. De Curtis and colleague documented that 22% VLBW infants were SGA at birth whereas at 36 weeks corrected age 97% had growth failure.[(18)]

The time for regaining birth weight in this study is 16 days (range 12 to 22) whereas Ehrenkranz [19] documented the time of regaining birth weight of 11 to 18 days. The median percentage of weight loss is 7.69 (range 3.14 to 13.4) which is less than that reported by Senterre [20] and collaborator.

The only factor associated with poor Z score at discharge was the number of days nil per os without parenteral nutrition. This is in keeping with reports that an aggressive nutrition approach, starting parenteral nutrition on the first day of life, prevents growth failure.[21] The findings of this study suggest that an aggressive enteral feeding before 24 hours of life is beneficial as it will cause the decrease of infants nil per os without parenteral nutrition.

The mean growth velocity of the present study is 13.2 g/kg/day which is close to that of other reports [13, 17] but below the recommended growth velocity of 15 g/kg/day.[13] The recommended growth velocity of 15 g/kg/day is a growth velocity of babies after infants have gained their birth weight [4]. Growth velocity in the current study was calculated using day 7, rather than the day birth weight was regained, as the baseline. Other researchers have also used this starting point as this is the time when postnatal weight loss has reached its nadir. [12] Using the day of regaining birth weight as the starting point would possibly give a growth velocity closer to the recommended 15 g/kg/day.

The study has shown a negative impact of antenatal steroids on growth comparable to finding of Kumar et al. who documented an increased incidence of infants with weight below the 10th percentile at discharge after exposure to multiple doses of antenatal steroids.[22]

Conclusion

The present study has shown that the growth velocity of VLBW infants in CMJAH approaches the recommended norms. In a resource limited setting where an aggressive parenteral nutrition is not feasible the study has shown an extra uterine growth failure at discharge and an association between z score for weight at discharge and number of days nil per os without parenteral nutrition. This study has also shown a negative impact of antenatal steroids on good growth velocity of VLBW infants. More liberal use of parenteral nutrition may improve postnatal growth in this population.

Conflict of interest: none

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